A DISCUSSION OF THE REPORT OF THE COMMITTEE ON THE UNIFICATION OF MATHEMATICS.[1]

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The report of the committee made in the meeting last year I find reasonable, conservative, and admirably expressed. Its suggestions are in harmony with the trend of instruction given in the secondary schools of England and of Germany. And while the movement for unification in the United States progresses slowly, I believe it possesses great things for the high school pupils who enter immediately upon a wage-earning career.

A glance into the mathematical texts of the correspondence schools shows that those alert purveyors of instruction have cut to the quick in their efforts to combine elementary mathematics within the scope of a single work. A bird's-eye view of a subject is a good thing to get. The secondary school pupil should get considerable practice in the fundamental operations of mathematics and some glimpse of the possibilities of the subject. Unification would permit of more time for practice in the technique of the subject and give the pupils an acquaintance with at least four phases of mathematics: arithmetic, algebra, geometry, and trigonometry. Then, too, we must keep out of the way of the psychologists who are asking embarrassing questions about some of the subjects now in the secondary school curriculum. Whatever enables correlation of our work with the other courses in the curriculum makes for added strength in our position. Unification and real problems will give us the means of enriching our material and keeping the work attractive.

Too many studies are taken in the different high school courses for the students to attain precision, suggests Superintendent Ella Flagg Young. Princeton, several years ago, reduced the number of entrance requirements to give opportunity for better preparation in a few subjects. President Lowell in one of his inaugural talks to the students pointed out the desirability of carrying some few subjects throughout the college course. The unification of secondary mathematics would be in harmony with these ideas, for it makes it possible to offer pupils a connected body of

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work extending through the four years of the secondary courses. Latin has maintained its prestige partly because there have been offered four years of closely related work in that language in the high schools since their establishment.

I am tempted to give here some of the defense that might be offered for a good deal of satisfaction in the present status of secondary mathematics. Yet when I make the summary there still remains the feeling that one of the most valuable improvements will come through some such unification as the committee has outlined in its proposed four years' course. My teaching experience gives me this feeling. We must advance in our chosen work or lose ground. There is no standing still. But in what can we find satisfaction? It lies in these circumstances, I fancy. The present work is good preparation for the colleges, because the first year reports of many students in college mathematics show high grades. And the patrons of the schools appreciate the fact that their young people are prepared for college entrance either by certificate or through the College Entrance Board. Moreover, the criticism of the business world is directed at arithmetical errors and the work at the present gives much practice in the use of numbers. Texts like the Wheeler, and the Young and Jackson give numerous oral exercises. Then, too, the criticism of the science teachers that the pupils could not solve formulas is admirably cared for in new texts such as the Slaught and Lennes, and the Collins, though most fully treated perhaps by G. W. Evans in a book the publishers dropped because it did not go. We can continue to believe that our subject is of much interest to the pupils, for in our school a study of the enrollment and the number taking mathematics during the last five years shows that although mathematics is an elective study and not required for graduation the mathematics classes have been 54%, 59%, 70%, 63%, and 65%, respectively, of the entire enrollment. The 70% was reached the year that the most courses in mathematics were offered. We can point to decided progress being made towards simplification through the elimination of numerous topics, the addition of a considerable number of concrete problems based on commercial, physical, and geometrical formulas, census data and shop work. Then there is the use of squared paper, colored crayon, the slide rule, and the stereopticon to present different cases in construction problems. And lastly we possess the

illuminating works of David Eugene Smith and J. W. A. Young in their pedagogical and historical writings on mathematics.

But what can be done toward unification by the teacher in the non-technical high school, with the probability of the instructors having to give instruction in one subject other than mathematics, with only the training given the Bachelor of Arts graduate in mathematics ten or twenty years ago and the consequent narrow view of the field, and with the demands of the home and society upon his time, and his efforts to add perhaps to an inadequate salary by tutoring or gardening? It would seem as though such a teacher must depend largely upon the texts offered for his selection.

The old Wentworth, the Fisher and Schwatt, the new Wells, Milne's Academic, the Aley and Rothrock, the Beman and Smith Academic, Myers' First Year Mathematics, and the Young and Jackson have been used as algebraic texts at different times during the past eight years in our school. During the same period six different geometries have been tried. It is evident that great freedom in the selection of texts is allowed some of us mathematics instructors in the secondary schools. Many of us who cannot and should not make the texts, can and do select our books.

The text making must lie with Messrs. Comstock, Slaught, Collins, Hedrick, Myers, Young, Millis and any others whose training has given them a broad view of the subject. Such books as Mr. Myers' First Year Course in Mathematics and his Geometric Exercises bring into a close bond algebraic, geometric, and physical notions and formulas and put into the hands of the ordinary mathematics instructor, material which he can and will gladly present and interpret to his pupils.

Mr. Castle has unified the mathematics of the secondary school somewhat in his Practical Mathematics for Beginners. He uses arithmetic, algebra, geometry, trigonometry, squared paper, and the slide rule in a small volume of a few hundred pages. But the problems are of English significance and not nearly so human as the problems found by Mr. Millis's committee on real problems, or as those Dr. Slaught, Dr. Collins or Dr. Myers so effectively use in their secondary texts. If we are to continue the heuristic rather than the genetic plan of recitation and give out home work, we need texts and readily available sources for problems.

When I used Myers' First Year Mathematics the first year it was offered to the public and had to supplement the book continually by assignments of work in the old style texts in order to give the pupils the amount of discipline it seemed to me that they should have, I found it a task which I was willing to shirk the next year. What I wanted was several times the amount of the same general material. The latest edition of the text in question has about twice the amount of subject matter. The classes that year did pages of the text at a sitting. But I found no supplementary texts.

Just as the College Entrance Board has gradually granted the demands of the teachers in the contributory schools and brought the examinations conducted by the Board to represent the best sense of the body militant among the instructors, so the men of the larger view and the deeper learning have it in their power to give to the lesser lights among the mathematics teachers the fruits of scholarship and to write suitable texts making a close union of that part of elementary mathematics that they consider essential to the secondary schools. The teachers will use such books to the best of their ability, I believe.

In regard to the outlined four years' course offered by the committee, I want to ask that the committee (a) take some current text in geometry and indicate the propositions of small value that they would eliminate in the second year's work in geometry; (b) that in Third and Fourth Year, Part I, they would illustrate by reference to some present text "certain theorems of plane geometry that may have been left for treatment here"; (c) that in solid geometry they would give definite reference to "theorems of small value."

We teachers who have to prepare some pupils all the time for eastern colleges must know definitely what the college considers essential. The head of the mathematics department in one of the largest township high schools in Illinois told me recently that one of his students had been prepared in trigonometry in a text that did not emphasize the matter of radian measure. The boy took the entrance examination in trigonometry at one of the largest eastern universities and three of the five questions involved the use of the radian. That high school now uses a trigonometry written by a professor in the university in question. The instructor cannot afford to be caught that way again. It hurts the prestige of his school. To me the

outline seems wholly feasible. Its scope is within the capacities of the instructors and the time limit allowed for mathematical work. And the proposed unification means economy in presentation of vocabulary, a knitting together of dependent ideas, a constant review of the old material, and a perspective of additional knowledge, and pleasure in the study of mathematics.

DISCUSSION OF THE UNIFICATION OF SECONDARY MATHEMATICS.[1]

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The Central Association is getting its bearings. For several years now it has been trying to improve mathematical teaching. Many experiments have been tried; many schemes have failed. But we now see light. The report on unification of mathematics read by Mr. Cobb shows wherein, to a great degree, the real trouble with mathematics lies.

In science work, in all applied mathematics one does not use arithmetic, algebra, geometry, trigonometry. One uses *mathematics.*

Until now we have built up a systematic course in arithmetic; followed this with a somewhat vigorous course in algebra, then came a course in geometry, carefully compiled so that few rules of logic were violated and every rule of pedagogy forgotten.

Throughout each course were glaring sign posts:

"We must not do *this* because *that* has not been proven."

"We must not do *this* because *that* has not been defined."

"We cannot admit this problem in algebra because it is essentially arithmetical."

One of the greatest difficulties arising from the teaching of mathematics in compartments, is that arithmetic and algebra are taught largely as memory and rule of thumb processes, then comes a geometry course that is all thought process, and all three subjects suffer.

I have been asked to discuss our committee's report on unification. Perhaps as satisfactory a discussion as I can offer is a report of what my teachers have accomplished in the past year.

This report offered by the committee is necessarily general in its nature. It is my purpose to give the report my support, show

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